APPENDIX P: Summary of Post-Workshop Scientific Input Solicited by NETN on Vital Sign Selection

Following the Vital Signs Selection Workshop in May 2004, NETN solicited additional scientific input from a select group of scientific experts in the fields of biogeochemistry and remote sensing to address lingering questions in those areas. The scientists contacted were: Dr. Tim Fahey of Cornell University, Dr. Scott Ollinger of the University of New Hampshire, Dr. Kathleen Weathers of the Institute for Ecosystem Studies, Dr. Marie-Louise Smith of USFS, and Dr. Lindsey Rustad of USFS. Their responses are summarized herein.

Biogeochemistry

Tim Fahey, Kathleen Weathers, and Lindsay Rustad all pointed out that a few, inexpensive measures of streamwater biochemistry would be very useful for interpretation of acid deposition and nitrogen saturation stresses. These measures include streamwater nitrate, pH and acid-neutralizing capacity (ANC). Dr. Rustad also advocated incorporating measures of streamwater phosphorus, base cations, DOC and metals, and noted that the seasonality of streamwater response is important. NETN has included streamwater measures within our Acid deposition and Water chemistry Vital Signs.

Tim Fahey suggested that additional biogeochemical measures may indeed by too expensive. However, Scott Ollinger and Lindsay Rustad suggested that a few additional measures of nutrient cycling would very helpful in better interpreting the impact of acidic deposition and nitrogen saturation. Both advocated monitoring of soil nitrogen mineralization. Dr. Rustad pointed out this measure could be done less frequently than annually – perhaps every 5 years. She also advocated monitoring pH, cations and Al:cation ratios in the soil. Dr. Ollinger further suggested monitoring soil C:N ratio and foliar N concentration, as these "would help to assess whether things like low base saturation and Ca:Al ratios are due to N deposition stress. Additional foliar nutrients would also be useful in that nutrient ratios (N:Ca) are often indicative of stress." NETN has attempted to include some of these measures into our Acid deposition Vital Sign.

Dr. Ollinger further noted that species composition of dominant forest vegetation is essential information because changes in ecosystem health can be manifested through shifts in species composition, and also because interpretation of other indices will vary according to species. "For instance, low base saturation in soils could be a cause for concern in a sugar maple stand, but is not necessarily a cause for concern in species such as beech or hemlock that tolerate more acidic soil conditions." He suggested we consider the work of Gary Lovett at IES for information on species interactions with nutrient cycles and differential responses to atmospheric deposition.

Occult deposition

Kathleen Weathers has studied occult deposition at Acadia and found it is an important component of total deposition at that site. She is currently developing a model of total deposition inputs (including occult) for Acadia, and will send us a preprint of this work when it is available. We may be able to use her model to assess total deposition from existing NADP and CASTNET monitoring. We are currently seeking input from NPS Air quality personnel

(Kristi Morris) on this possibility. Dr. Weathers also suggested that it would be useful to monitor throughfall flux and fog chemistry at some locations if funds permit.

Dr. Ollinger suggested we also explore the work on occult deposition of UNH's AIRMAP group.

Remote sensing

We are awaiting a written response from USFS hyperspectral remote sensing scientist Marie-Louise Smith. Verbal communication with her indicates that a Vegetation stress index from hyperspectral remote sensing could be a useful indicator of forest canopy vegetation condition. Drs. Smith and Ollinger point out that MODIS data would not be sufficient for this indicator because MODIS ecological data is calibrated for western forests and may be inappropriate for our systems, and also because the spatial resolution is too coarse. Dr. Smith suggests that hyperspectral remote sensing from sources such as the Hyperion sensor on EO-1 may become affordable soon, and may provide a useful data source for this indicator. Currently, a 7.5 km X 100 km Hyperion scene costs about $1500. However, some archived data may be available for only $250 per scene. NETN has included this indicator as a potential measure of our Forest vegetation Vital Sign. Depending upon the availability of archived data, it may be affordable to include this measure at some sites now or sometime in the future.

Dr. Ollinger also suggested a simpler alternative for "assessing changes in growth" of vegetation - "plot-level biomass measurements or analysis of tree cores. As with other variables, changes in growth would need to be interpreted with respect to natural variability caused by factors such as species and stand age before drawing conclusions about health and pollution effects." Tim Fahey suggests that NPP may be too expensive to monitor on a plot basis, but that plot-level measurement of tree/shrub mortality would be very useful. NETN has included a mortality measure within the Forest vegetation Vital Sign.

Dr. Ollinger further advocated a measure of forest crown condition as a high priority. He noted that there are many methods available, including subjective visual assessments. He suggested we consider using standardized measures of crown optical properties such as light penetration, gap fraction and leaf area index using digital canopy photos such as the "HemiView system" which includes software designed to calculate properties of vegetation canopies. He noted that this information could even more useful be combined with remote sensing data. NETN has included crown condition as a potential measure within the Forest vegetation Vital Sign.

Other comments

Tim Fahey highlighted the value of monitoring selected indicator species across parks, and advocated including a broad taxonomic range. He said, "I strongly believe indicator species populations from a slew of functional or taxonomic groups would be most useful and in line with NPS objectives." He further noted, "if some NPS funds could be used to monitor selected populations of indicator species in most of the parks, that would establish a valuable program. Choice of taxa probably would vary among parks and should include multiple functional groups, with selections based upon sensitivity to stresses most likely impacting each park." NETN recognizes the value of this approach, and has attempted to include the monitoring of select populations of plants, birds, amphibians, and insects within our list of Vital Signs.

Lindsay Rustad advocated elevating Phenology to a high priority Vital Sign. She noted that phenological measures are straightforwad to collect, and could serve as a valuable indicator of long-term climate change. NETN agrees with this assessment, and has elevated Phenology to high priority. Dr. Rustad further noted she did not find deer herbivory to be a top priority.

Finally, Tim Fahey noted that the Long-term Ecological Research (LTER) program could be a valuable partner to the NPS in this endeavor, and that we should consult available LTER protocols. NETN agrees and plans to do so.